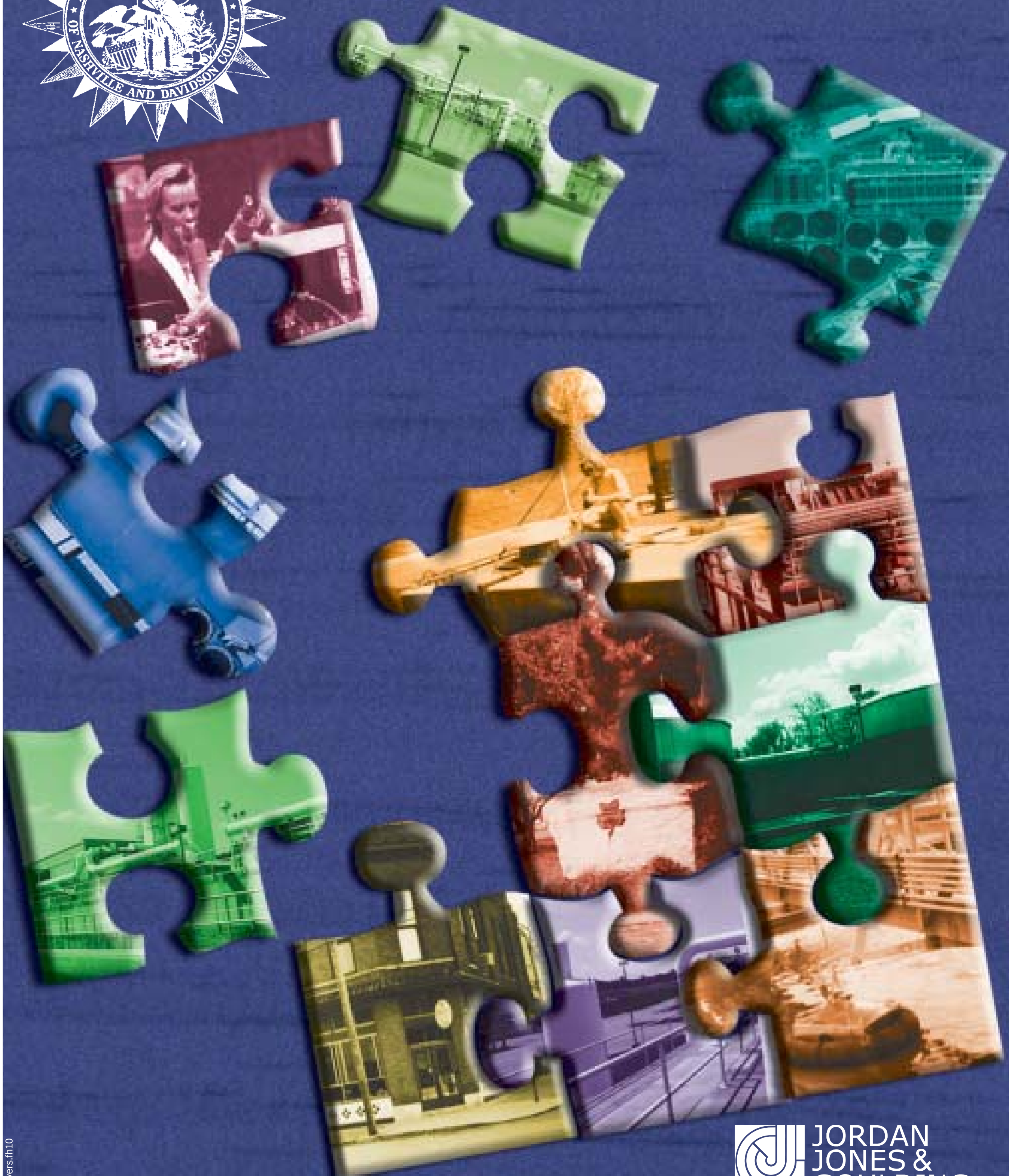
Odor Identification and Control

Central Wastewater Treatment Plant

Metro Water Services

Metropolitan Government of Nashville and Davidson County

Executive Summary



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Executive Summary

Traditionally, odors emitted from treatment plants have been considered a necessary evil of treating wastewater. Most treatment plants were located in relatively isolated or industrial areas, resulting in little concern for the adjoining property owners. As communities expand, the areas around the wastewater treatment plants have become more populated, and control of odors has become a priority.

Metro Water Services has long been aware that odors from the Central Wastewater Treatment Plant (WWTP) have been a problem in the surrounding community. Beginning in the early 1990s, Metro Water followed a policy of providing odor control for new construction at any unit process that was considered to be a potential odor source. By the late 1990s, it was apparent that this policy was not resulting in any significant improvement in the odor problem. Metro Water Services determined that in order to be a good neighbor, the commitment would be made to address off-site odors comprehensively – and to approach the problem in an analytical manner to ensure resources are invested efficiently.

In late 2001, the odor evaluation was started. The project team consisting of Jordan Jones & Goulding, Huber Environmental and Metro Water Services, began to evaluate each unit process at the Central WWTP for odor sources.

The first step of the evaluation was to conduct public meetings to inform citizens about the study procedure and objectives. In addition, a focus group consisting of several residents of the area impacted by the odor problem was established. The focus group was informed about the details of the study throughout the process and had the opportunity to provide input where appropriate.

The next step of the evaluation was to identify all potential odors sources. Each of these sources was then sampled. Point sources (fans, pipes and vent stacks) were sampled by pumping the odorous air directly into a special sampling bag. Area sources (open tanks) were sampled by floating a specially designed hood on the water surface and pumping the odorous air into the sample bag. The sample bags were then shipped overnight to Atlanta for sensory analysis.

Odor is a threshold science. Every odor has a threshold concentration, which is the concentration at which the odor can barely be detected. By determining how many dilutions of fresh air are needed to reduce the concentration of an odor to the threshold concentration, the relative strength of the odor can be determined. This relative strength is expressed as the dilution to threshold ratio (D/T). A panel of people who have been evaluated to determine their sensitivity to odors was used to evaluate the odor samples. For each sample, the relative strength of the odor (D/T) was determined as well as the odor's tendency to linger in the environment.

For each odor source, an exhaust rate was also determined. The exhaust rate is the volume of odor released. When the exhaust rate is multiplied by the D/T, which is an odor concentration, the result is the emission rate, which is the mass of odor generated by the source per unit of time.

The odor emission rates were used in a computer model to determine how far from the treatment plant each odor source would transport. The transport distances were then used to rank each odor source, since the odors that transport the farthest from the treatment plant must be controlled first.

The objective of the project was to prevent any odor source from crossing the property line of the facility. Each odor source that exceeded the objective was included in recommendations for control, and the amount of odor reduction required for each source to meet the property line objective was determined. The odor sources recommended for control in priority order are shown in Table ES-1.

From the odor reduction requirements, a list of possible alternatives was developed. This list included the following types of control alternatives:

- Housekeeping changes - improvements in housekeeping that can result in odor reduction. These items can include more frequent wash down, removal of floating objects from basins, and other similar items.

Table ES-1
Odor Sources – Central WWTP

Odor Source	Control Method
Total Dewatering Building	Included in Bio-solids project
Total North Scrubber Exhausts	Structural – previously covered, change treatment technology
Total North Primary Clarifiers	Structural – cover and treat
Aeration Basins	Process change
South Primary Clarifiers	Process change
Primary Effluent Channel	Structural – cover and treat
Aeration Influent Channel	Process and housekeeping change
Screw Pumps	Structural – cover and treat
Old Grit Channel	Abandon if possible

- Process changes – changes in the way that the treatment plant is operated. These types of changes can include taking basins out of service, increasing aeration or adding chemicals
- Structural changes – improvements that require construction, such as covering basins and treating the captured odors.

Many alternatives are available for odor treatment, but only two are practical for treating large volumes of air. The two alternatives are packed bed scrubbers and bio-filters. Packed bed scrubbers remove odors by chemical treatment. They are generally less expensive to construct, but more expensive to operate because of the chemical costs. Bio-filters use bacteria to remove odors. Because bio-filters use a naturally occurring process, the operating costs are low, but they are more expensive to build.

The following housekeeping changes are recommended for the Central WWTP:

- Aeration Influent Channels - Remove debris from the influent channel to the aeration basins on a more regular basis.
- Final Clarifiers - Control scum on the final clarifiers. If scum does form, remove the scum as soon as possible.

Process changes are also recommended. They include:

- North Grit Chamber Influent – Change operation of the Brown's Creek Pump Station force mains to reduce peaks of hydrogen sulfide at the North Grit Chamber.
- Aeration Basins – Control the dissolved oxygen levels in the aeration basins to prevent low dissolved oxygen and formation of scum.
- South Primary Clarifiers – Limit use of the South Primary Clarifiers as much as possible. If the use of these clarifiers cannot be limited, consider odor control.
- Aeration Influent Channel – Eliminate channel aeration in the Aeration Influent Channel, and reevaluate odors if necessary.

Areas recommended for structural control of odors include:

- North Grit Area
- Primary Clarifiers, including the influent channel, quiescent area, weir area, and effluent channel.
- Screw Pumps
- Sludge Dewatering Buildings.
- Old Grit Channel, if the channel cannot be abandoned.

Evaluation of the alternatives for structural odor control used net present value (NPV) so that the impact of operating cost was included in the evaluation. NPV is the sum of the construction, or capital, cost of the alternative plus the amount of money that would be required in a savings account today to fund operation of the alternative for the next 20 years. Table ES-2 lists the scrubber alternative and the bio-filter alternative that are the most cost effective and allow the greatest ease of operation and their NPV.

Based on the analysis of the alternatives, one bio-filter to treat all of the odor sources from the liquid treatment processes is recommended. This alternative has the added benefit of being the most environmentally responsible alternative because a naturally occurring process will be used to reduce odors. The estimated capital cost for the recommended alternative is $11,798,000.

Treatment of odors from the solids treatment processes will be included with the proposed bio-solids improvements project. The bio-solids project will replace the existing sludge dewatering processes with new anaerobic digesters for sludge stabilization, new dewatering facilities and a heat drying facility.

Table ES-2
Net Present Value Comparison

Description	Capital Cost $	Operating Cost $/year	Net Present Value $
Two scrubbers in separate locations for the liquid train	9,259,000	754,000	18,653,840
One bio-filter for the liquid train	11,798,000	206,700	14,373,482